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(54) **METHOD AND SYSTEM FOR INSERTING DIGITAL VIDEO EFFECTS INTO A VIDEO STREAM AT A MULTIPLEXING DEVICE AFTER ROUTING**

(75) Inventors: **Michael R. Munsell**, Playa del Rey, CA (US); **Carl Ostrom**, Nevada City, CA (US); **Mitchell B. Wasden**, Redondo Beach, CA (US)

(73) Assignee: **The DIRECTV Group, Inc.**, El Segundo, CA (US)

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(51) **Int. Cl.**

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H04N 21/235	(2011.01)
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H04N 21/435	(2011.01)
H04N 21/81	(2011.01)

(52) **U.S. Cl.**

CPC ***H04N 21/2665*** (2013.01); ***H04N 21/235*** (2013.01); ***H04N 21/2381*** (2013.01); ***H04N 21/435*** (2013.01); ***H04N 21/812*** (2013.01)

(58) **Field of Classification Search**

CPC H04N 21/2665; H04N 21/435; H04N 21/812; H04N 21/4331; H04N 7/165

See application file for complete search history.

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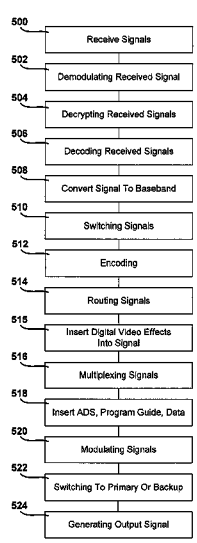
Primary Examiner — Rong Le

(57) **ABSTRACT**

A system and apparatus for generating an output signal includes a receiving system **160** generating a plurality of signals having a first format, an encoder **182** encodes the plurality of signals into a plurality of transport streams and a multiplexer **210**. A local area network **130** routes the plurality of transport streams to the multiplexer **210**. The multiplexer **210** combines the transport streams to form a combined signal and inserts a digital video effect into the combined signal. A modulator **214** modulates the combined signal to form a modulated signal. A system **202** forms the output signal from the modulated signal.

19 Claims, 7 Drawing Sheets



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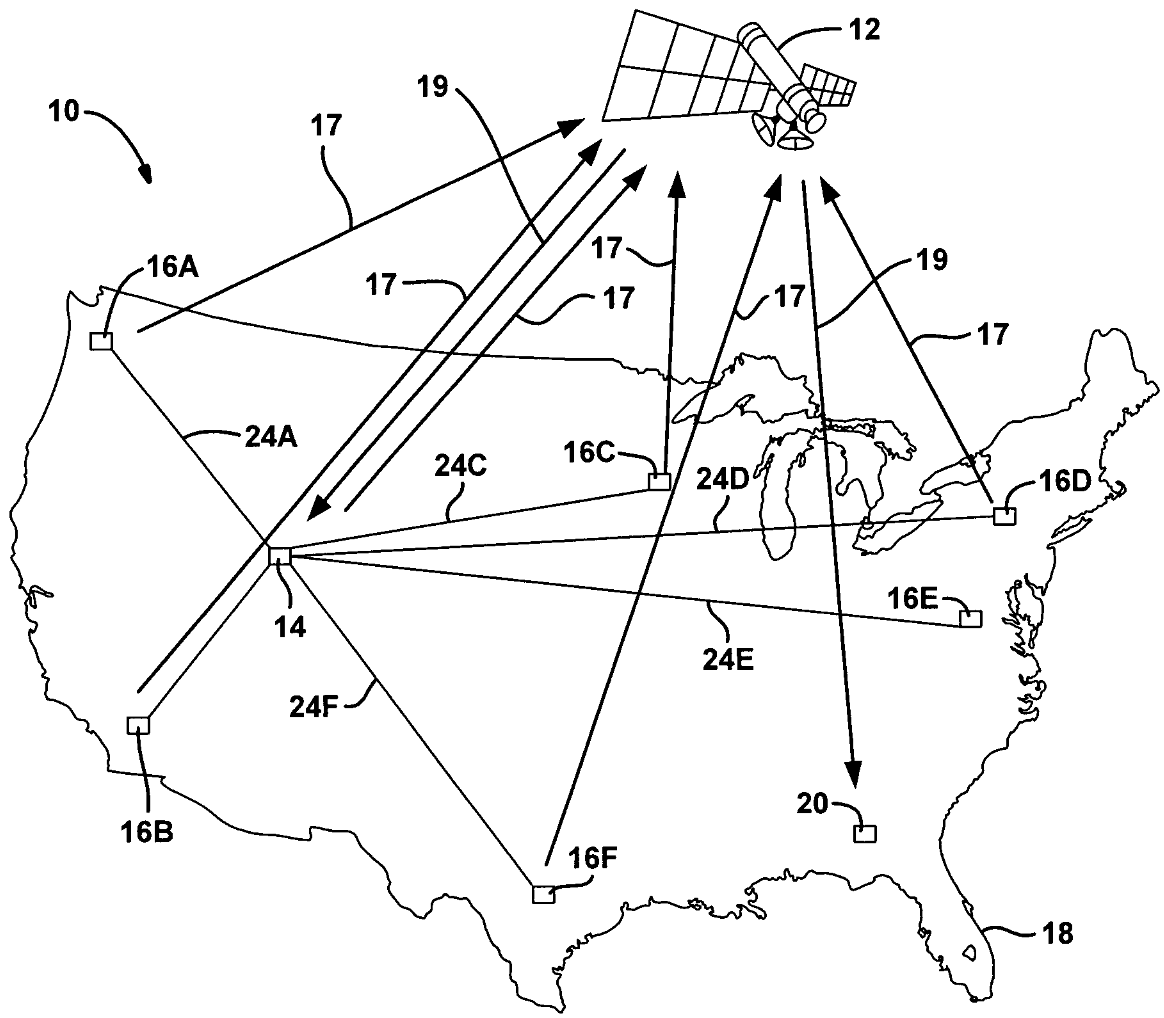

10
12
19
17
17
17
17
16A
17
19
17
17
24A
16C
24C
24D
16D
16E
14
24E
24F
16B
20
16F
18

FIG. 1

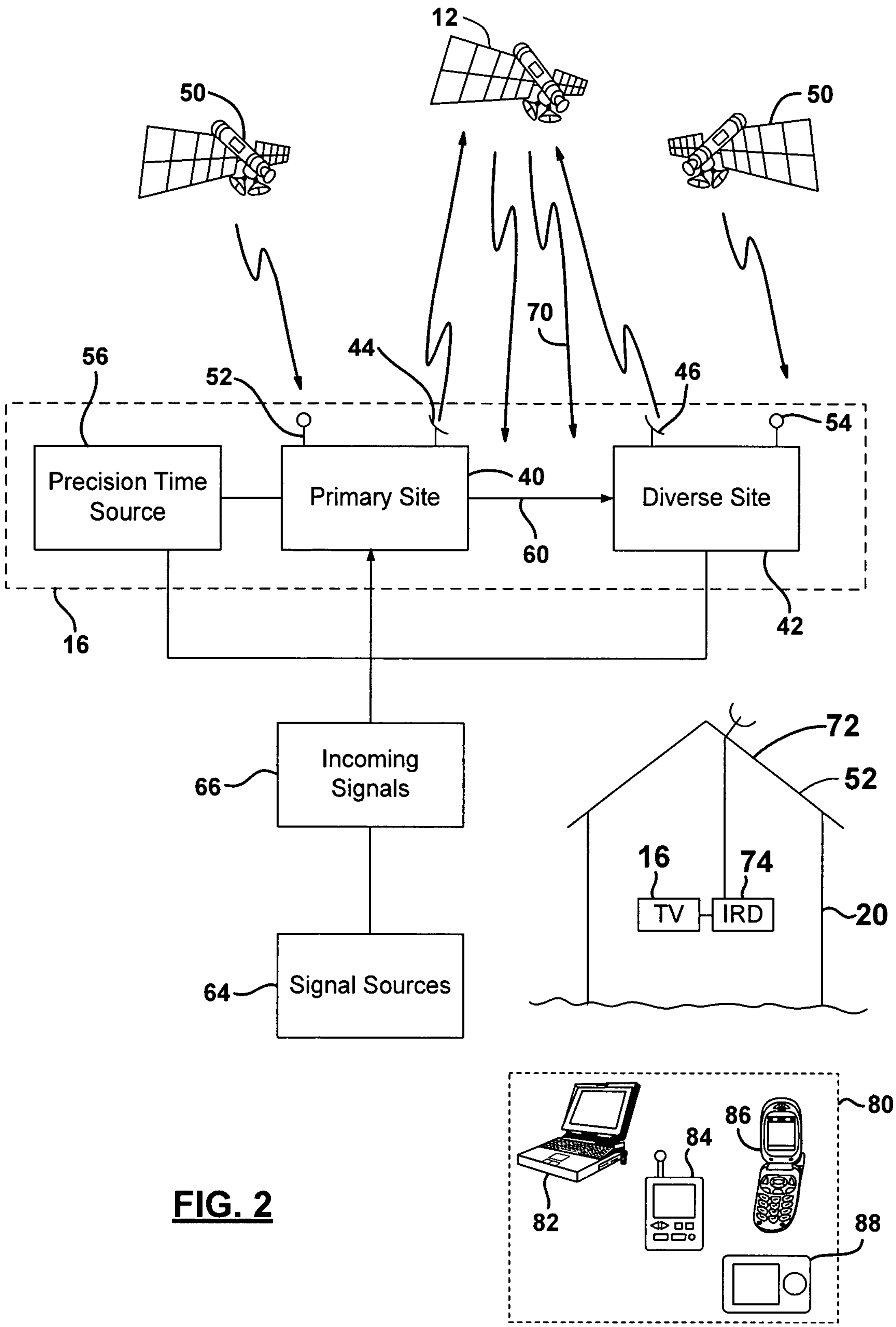

12
50
50
70
56
52
44
46
54
Precision Time Source
Primary Site
40
Diverse Site
60
16
42
72
52
Incoming Signals
66
16
74
TV
IRD
20
64
Signal Sources
80
86
84
82
88

FIG. 2

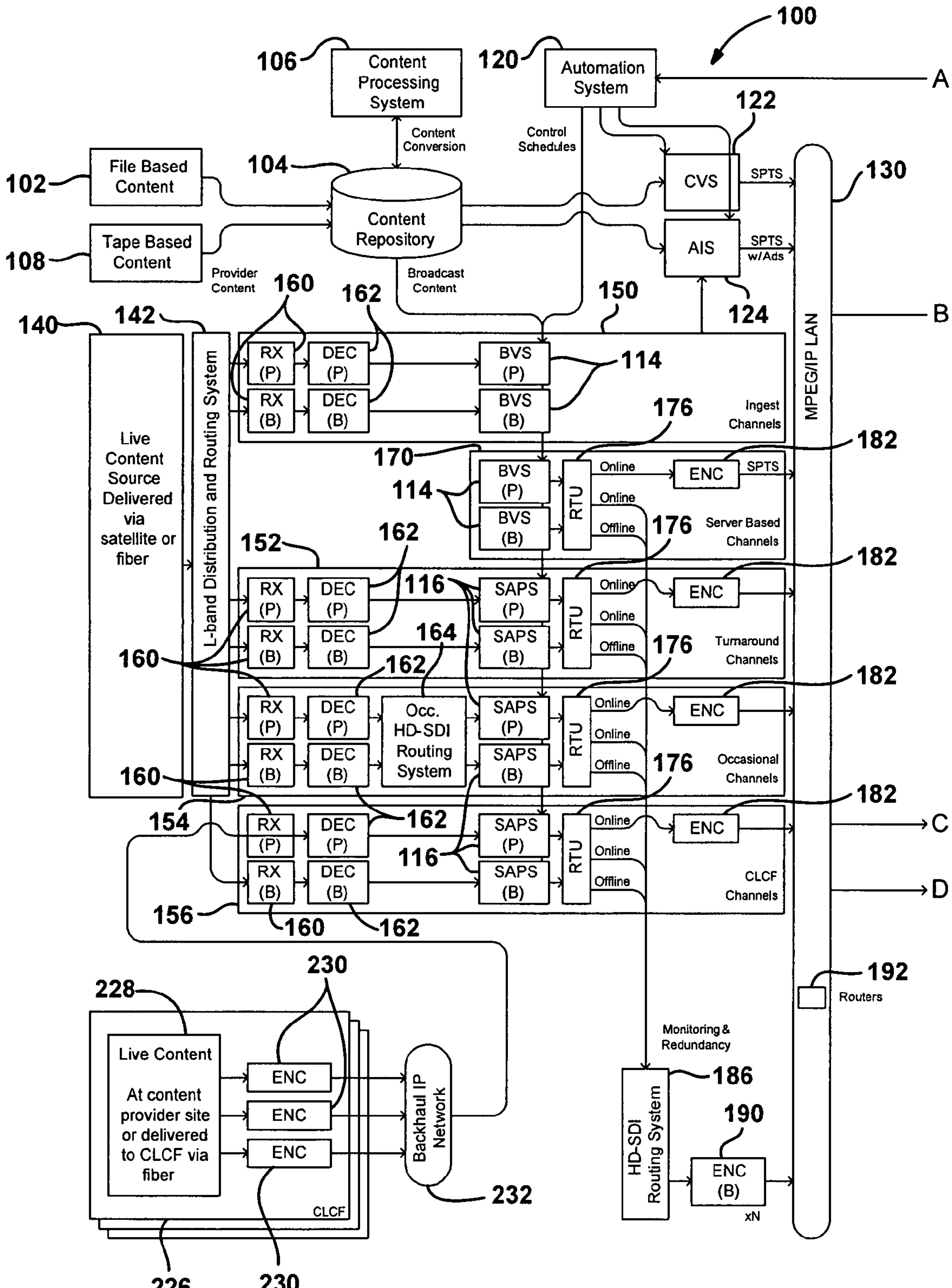

100
106
Content Processing System
120
Automation System
A
Content Conversion
Control Schedules
122
102
File Based Content
104
Content Repository
CVS
SPTS
130
108
Tape Based Content
AIS
SPTS w/Ads
Provider Content
Broadcast Content
124
B
MPEG/IP LAN
140
142
150
160
162
Live Content Source Delivered via satellite or fiber
L-band Distribution and Routing System
RX (P)
RX (B)
DEC (P)
DEC (B)
BVS (P)
BVS (B)
114
176
Ingest Channels
170
RTU
Online
Offline
ENC
182
Server Based Channels
152
116
SAPS (P)
SAPS (B)
164
Turnaround Channels
Occ. HD-SDI Routing System
Occasional Channels
154
CLCF Channels
C
D
156
192
Routers
228
230
Live Content
At content provider site or delivered to CLCF via fiber
Backhaul IP Network
CLCF
232
226
Monitoring & Redundancy
186
HD-SDI Routing System
190
ENC (B)
xN

FIG. 3A

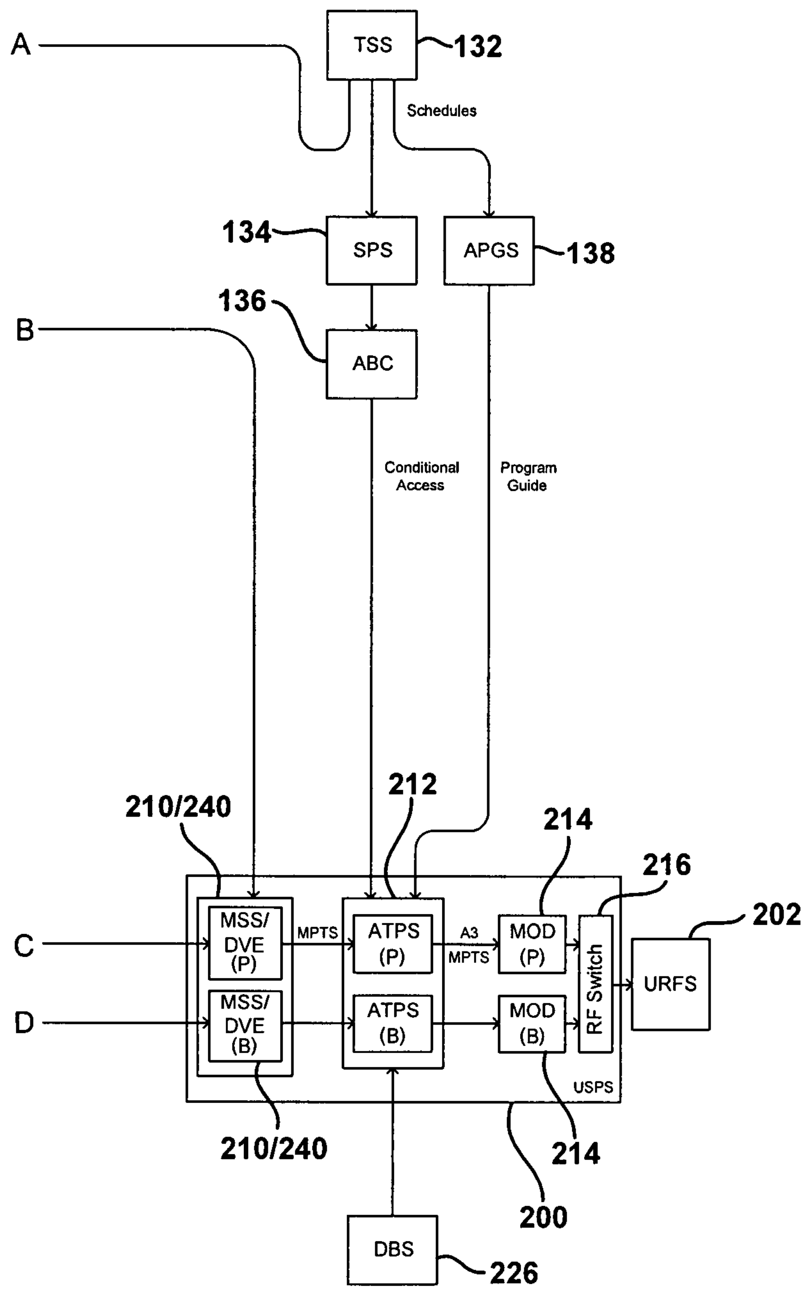
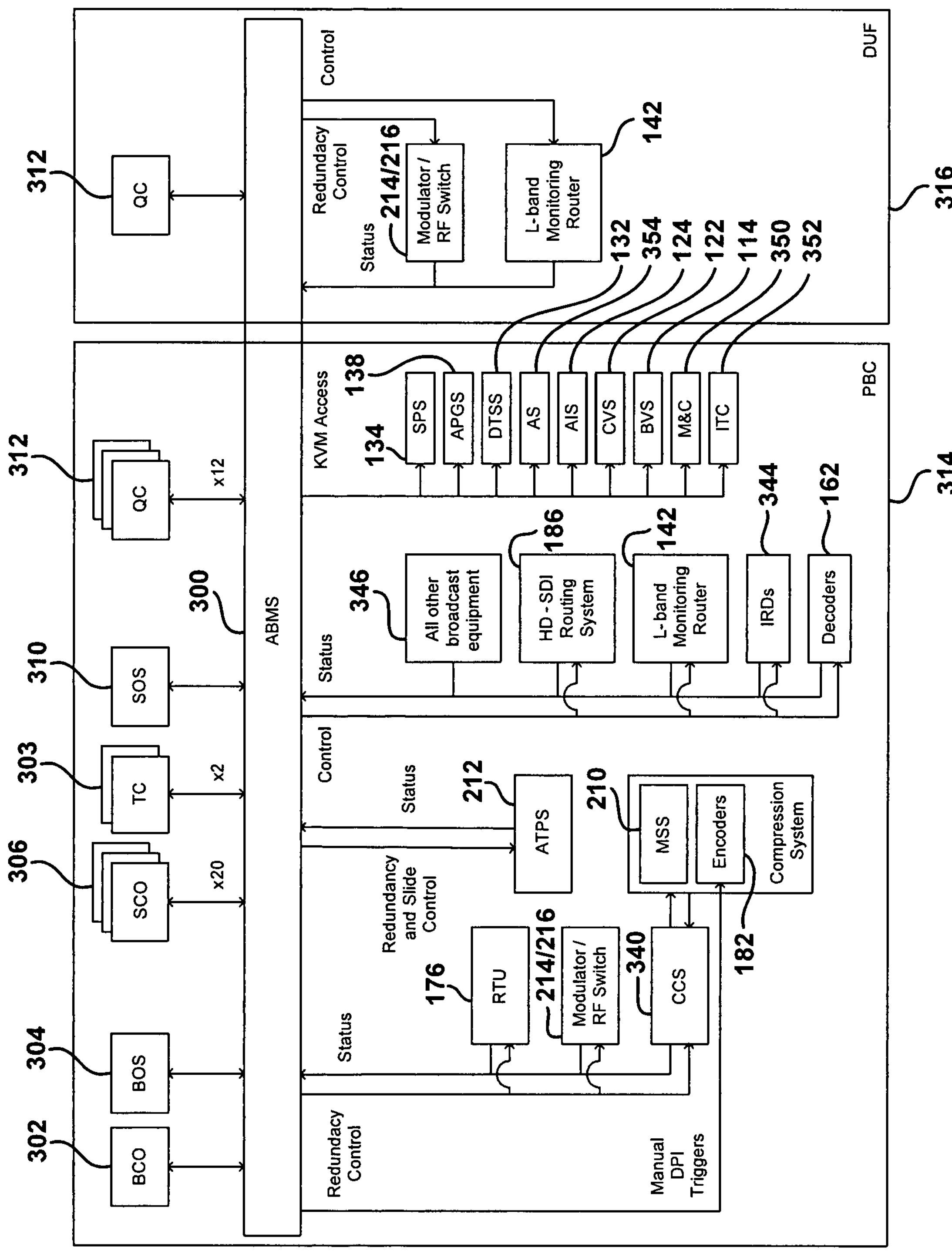

A
TSS
132
Schedules
134
SPS
APGS
138
136
B
ABC
Conditional Access
Program Guide
210/240
212
214
216
202
C
MSS/ DVE (P)
MPTS
ATPS (P)
A3 MPTS
MOD (P)
RF Switch
URFS
D
MSS/ DVE (B)
ATPS (B)
MOD (B)
USPS
210/240
214
200
DBS
226

FIG. 3B



DUF
PBC
ABMS
300
QC
312
SOS
310
TC
303
x2
SCO
306
x20
BOS
304
BCO
302
x12
316
314
Control
Redundancy Control
Status
Modulator / RF Switch
214/216
L-band Monitoring Router
142
KVM Access
SPS
APGS
DTSS
AS
AIS
CVS
BVS
M&C
ITC
134
138
132
354
124
122
114
350
352
All other broadcast equipment
346
HD - SDI Routing System
186
IRDs
344
Decoders
162
ATPS
212
MSS
210
Encoders
Compression System
182
Redundancy and Slide Control
RTU
176
CCS
340
Manual DPI Triggers

FIG. 4

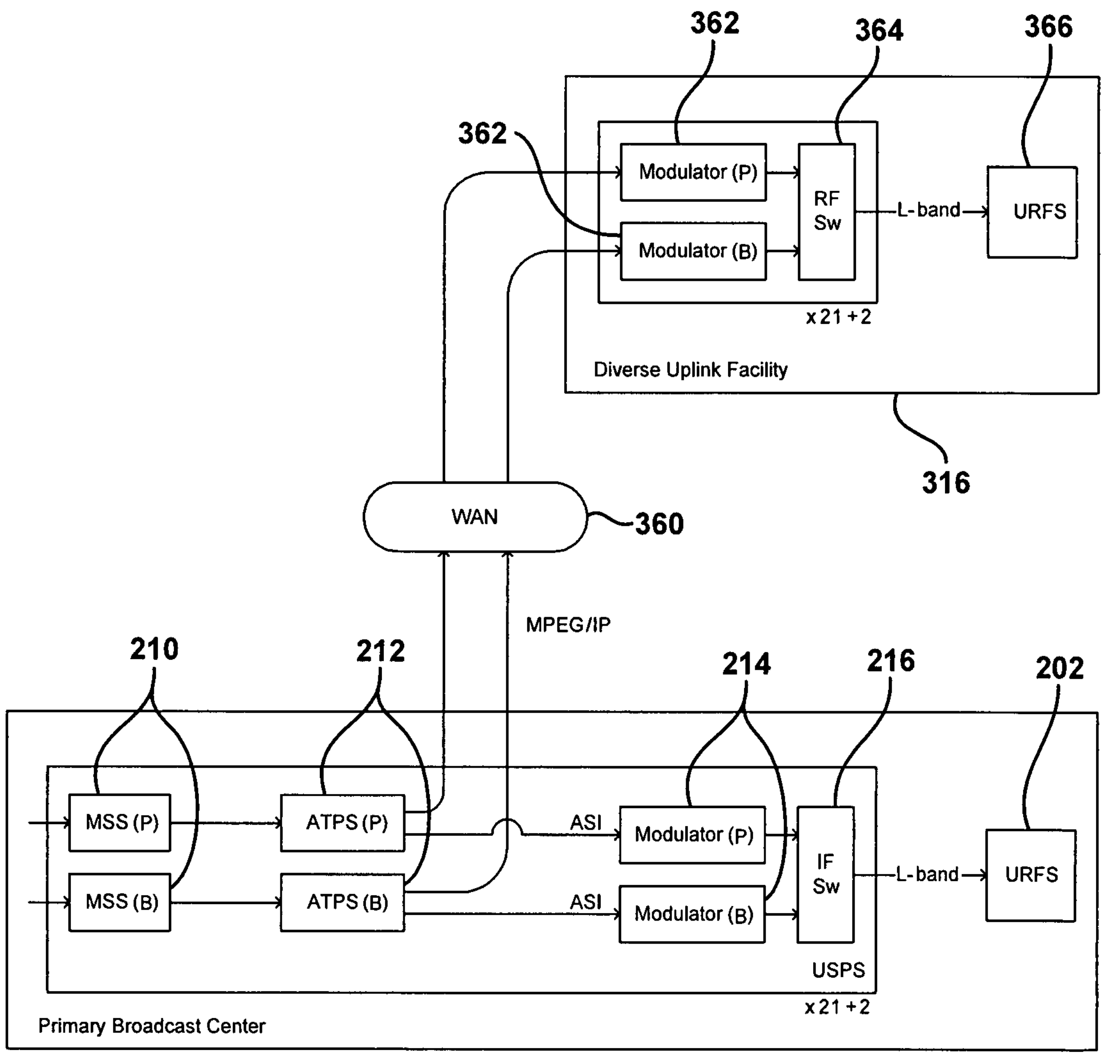

362
364
366
362
Modulator (P)
Modulator (B)
RF
Sw
L-band
URFS
x 21 + 2
Diverse Uplink Facility
316
WAN
360
MPEG/IP
210
212
214
216
202
MSS (P)
MSS (B)
ATPS (P)
ATPS (B)
ASI
ASI
Modulator (P)
Modulator (B)
IF
Sw
L-band
URFS
USPS
x 21 + 2
Primary Broadcast Center

FIG. 5

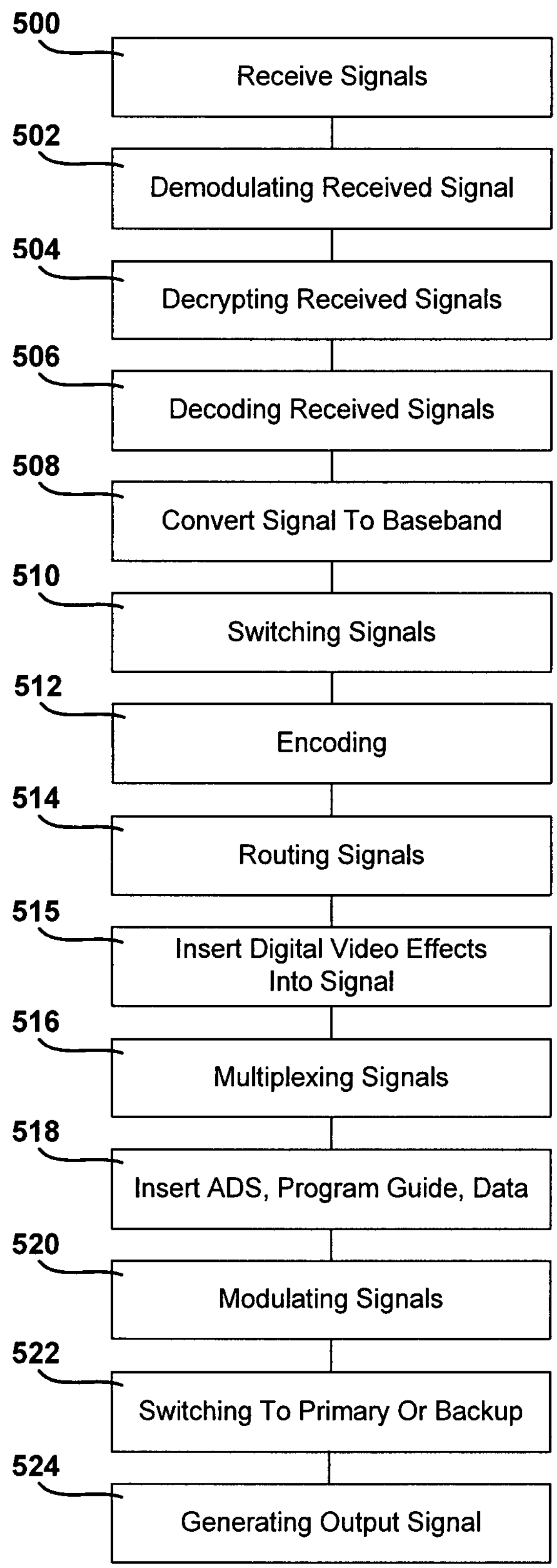

500
Receive Signals
502
Demodulating Received Signal
504
Decrypting Received Signals
506
Decoding Received Signals
508
Convert Signal To Baseband
510
Switching Signals
512
Encoding
514
Routing Signals
515
Insert Digital Video Effects Into Signal
516
Multiplexing Signals
518
Insert ADS, Program Guide, Data
520
Modulating Signals
522
Switching To Primary Or Backup
524
Generating Output Signal

FIG. 6

METHOD AND SYSTEM FOR INSERTING DIGITAL VIDEO EFFECTS INTO A VIDEO STREAM AT A MULTIPLEXING DEVICE AFTER ROUTING

CROSS-REFERENCES TO RELATED APPLICATIONS

This application is related to Utility application Ser. No. 11/728,378, filed Mar. 26, 2007, issued Dec. 31, 2013 as U.S. Pat. No. 8,619,822, entitled "Method and System for Generating Uplink Signals from a Ground Segment"; Ser. No. 11/728,552, filed Mar. 26, 2007, issued Apr. 26, 2011, as U.S. Pat. No. 7,934,228, entitled "Method and System for Marking Video Signals for Identification"; Ser. No. 11/728,501, filed Mar. 26, 2007, entitled "Method and System for Inserting Digital Video Effects into a Video Stream Using a Bypass Router"; Ser. No. 11/728,395, filed Mar. 26, 2007, entitled "Method and System for Inserting Digital Video Effects into a Video Stream After Bypass Routing and Before Encoding"; and, Ser. No. 11/728,379, filed Mar. 26, 2007, issued Aug. 7, 2012, as U.S. Pat. No. 8,239,913, entitled "Method and System for Inserting Digital Video Effects into a Video Stream in Redundant Paths Before Routing", filed simultaneously herewith. The disclosures of the above applications are incorporated by reference herein.

TECHNICAL FIELD

The present disclosure relates generally to satellite communication systems, and more particularly to a method and apparatus for forming uplink signals having digital video effects inserted therein.

BACKGROUND

The statements in this section merely provide background information related to the present disclosure and may not constitute prior art.

Satellite broadcasting of television signals has increased in popularity. Satellite television providers continually offer more and unique services to their subscribers to enhance the viewing experience. Providing reliability in a satellite broadcasting system is therefore an important goal of satellite broadcast providers.

High definition television offerings by major networks is continually increasing. Providing increasing high definition television programming to satellite television subscribers is desirable. For certain channels inserting digital video effects into a channel may be desirable. Digital video effects include overlays and changes to the picture screen. The digital video effects are desirable for many types of programming including but not limited to sporting events.

It would therefore be desirable to provide a method and apparatus to reliably insert digital video effects into a television signal.

SUMMARY

In one aspect of the invention, a method of forming an output signal includes receiving a plurality of signals having a first format, encoding the plurality of signals into a plurality of transport streams, after encoding, routing the plurality of transport streams through a local area network to a multiplexer, inserting digital video effects and multiplexing the signal to form a combined signal with digital video effects, modulating the combined signal to form a modulated signal and forming the output signal from the modulated signal.

In a further aspect of the invention, an apparatus for generating an output signal includes a receiving system generating a plurality of signals having a first format, an encoder encoding the plurality of signals into a plurality of transport streams and a multiplexer. A local area network routes the plurality of transport streams to the multiplexer. The multiplexer combines the transport streams to form a combined signal and inserts a digital video effect into the combined signal. A modulator modulates the combined signal to form a modulated signal. A system forms the output signal from the modulated signal.

One advantage of the invention is that input signals may be reliably processed so to insert digital video effects.

Further areas of applicability will become apparent from the description provided herein. It should be understood that the description and specific examples are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

DRAWINGS

The drawings described herein are for illustration purposes only and are not intended to limit the scope of the present disclosure in any way.

FIG. **1** is an overall system view of a satellite communication system in the continental United States.

FIG. **2** is a system view at the regional level of a satellite system.

FIGS. **3**A and **3**B are a continuous block schematic view of the system illustrated in FIGS. **1** and **2**.

FIG. **4** is a block diagrammatic view of the control portion of the system of FIG. **3**.

FIG. **5** is a schematic view of a primary and diverse site.

FIG. **6** is a flowchart illustrating switching logic for a primary and diverse site.

DETAILED DESCRIPTION

The following description is merely exemplary in nature and is not intended to limit the present disclosure, application, or uses. It should be understood that throughout the drawings, corresponding reference numerals indicate like or corresponding parts and features.

As used herein, the term module, circuit and/or device refers to an Application Specific Integrated Circuit (ASIC), an electronic circuit, a processor (shared, dedicated, or group) and memory that execute one or more software or firmware programs, a combinational logic circuit, and/or other suitable components that provide the described functionality. As used herein, the phrase at least one of A, B, and C should be construed to mean a logical (A or B or C), using a non-exclusive logical or. It should be understood that steps within a method may be executed in different order without altering the principles of the present disclosure.

The present disclosure is described with respect to a satellite television system. However, the present disclosure may have various uses including satellite transmission and data transmission and reception for home or business uses. The system may also be used in a cable system or wireless terrestrial communication system for generating an output signal.

Referring now to FIG. **1**, a communication system **10** includes a satellite **12**. The communication system **10** includes a central facility **14** and a plurality of regional facilities **16**A, **16**B, **16**C, **16**D, **16**E and **16**F. Although only one satellite is shown, more than one is possible. The regional facilities **16**A-**16**F may be located at various locations throughout a landmass **18** such as the continental United States, including more or less than those illustrated. The regional facilities **16**A-**16**F uplink various uplink signals **17** to satellite **12**. The satellites downlink signals **19** to various users **20** that may be located in different areas of the landmass **18**. The users **20** may be mobile or fixed users. The uplink signals **17** may be digital signals such as digital television signals or digital data signals. The digital television signals may be high definition television signals. Uplinking may be performed at various frequencies including Ka band. The present disclosure, however, is not limited to Ka band. However, Ka band is a suitable frequency example used throughout this disclosure. The central facility **14** may also receive downlink signals **19** corresponding to the uplink signals **17** from the various regional facilities and from itself for monitoring purposes. The central facility **14** may monitor the quality of all the signals broadcast from the system **10**.

The central facility **14** may also be coupled to the regional facilities through a network such as a computer network having associated communication lines **24**A-**24**F. Each communication line **24**A-F is associated with a respective regional site **16**. Communication lines **24**A-**24**F are terrestrial-based lines. As will be further described below, all of the functions performed at the regional facilities may be controlled centrally at the central facility **14** as long as the associated communication line **24**A-F is not interrupted. When a communication line **24**A-F is interrupted, each regional site **16**A-F may operate autonomously so that uplink signals may continually be provided to the satellite **12**. Each of the regional and central facilities includes a transmitting and receiving antenna which is not shown for simplicity in FIG. **1**.

Referring now to FIG. **2**, the regional facilities **16**A-**16**F of FIG. **1** are illustrated collectively as reference numeral **16**. The regional facilities **16** may actually comprise two facilities that include a primary site **40** and a diverse site **42**. As will be described below, the central site **14** may also include a primary site and diverse site as is set forth herein. The primary site **40** and diverse site **42** of both the central and regional sites are preferably separated by at least 25 miles, or, more preferably, at least 40 miles. In one constructed embodiment, 50 miles was used. The primary site **40** includes a first antenna **44** for transmitting and receiving signals to and from satellite **12**. Diverse site **42** also includes an antenna **46** for transmitting and receiving signals from satellite **12**.

Primary site **40** and diverse site **42** may also receive signals from GPS satellites **50**. GPS satellites **50** generate signals corresponding to the location and a precision timed signal that may be provided to the primary site **40** through an antenna **52** and to the diverse site **42** through an antenna **54**. It should be noted that redundant GPS antennas (**52**A,B) for each site may be provided. In some configurations, antennas **44** and **46** may also be used to receive GPS signals.

A precision time source **56** may also be coupled to the primary site **40** and to the diverse site **42** for providing a precision time source. The precision time source **56** may include various sources such as coupling to a central atomic clock. The precision time source may be used to trigger certain events such as advertising insertions and the like.

The primary site **40** and the diverse site **42** may be coupled through a communication line **60**. Communication line **60** may be a dedicated communication line. The primary site **40** and the diverse site **42** may communicate over the communication line using a video over internet protocol (IP).

Various signal sources **64** such as an optical fiber line, copper line or satellites may provide incoming signals **66** from the primary site **40** to the diverse site **42**. Incoming signal **66**, as mentioned above, may be television signals. The television signals may be high-definition signals. The incoming signals **66** such as the television signal may be routed from the primary site **40** through the communication line **60** to the diverse site **42** in the event of a switchover whether the switchover is manual or a weather-related automatic switchover. A manual switchover, for example, may be used during a maintenance condition.

In a terrestrial system, the satellites may be eliminated, used or replaced by transmission towers that use terrestrial antennas in place of antennas **46**. In a cable system, the antennas **46** may be replaced with optical fibers or copper wires.

Users **20** receive downlink signals **70** corresponding to the television signals. Users **20** may include home-based systems or business-based systems. As illustrated, a user **20** has a receiving antenna **72** coupled to an integrated receiver decoder **74** that processes the signals and generates audio and video signals corresponding to the received downlink signal **70** for display on the television or monitor **76**. It should also be noted that satellite radio systems may also be used in place of an IRD and TV for use of the satellite signals.

The user **20** may also be a mobile user. The user may therefore be implemented in a mobile device or portable device. The portable device **80** may include but are not limited to various types of devices such as a laptop computer **82**, a personal digital assistant **84**, a cellular telephone **86** or a portable media player **88**.

Referring now to FIG. **3**, a ground segment system **100** for processing content and forming an output signal is illustrated. One method for providing content is using file-based content **102**. The file-based content **102** may be in various standard formats such as CableLabs content, digital video disks or the like. The file-based content **102** is provided to a content repository **104** that stores the various file-based content. If needed, a content processing system **106** processes the content and converts the format of the file-based content. The content processing system may convert the video compression format, the resolution, the audio compression format and audio bit rates to match the target broadcast path. The content from the content repository **104** may be provided to various systems as will be described below. The content repository **104** may also receive tape-based content **108**. The tape-based content **108** may be processed in the content processing system **106** into various formats including a first format such as high-definition, serial digital interface (HD-SDI) format. The content repository **104** may provide content to baseband video servers **114**. The (P) and the (B) in the Figure denote a primary and secondary or back-up baseband video server. The content repository **104** may also provide signals to various service access processing systems **116**. As illustrated, several service access processing systems (SAPS) are illustrated. Both primary and back-up service access processing systems **116** may be provided in the various chains. An automation system **120** may control the insertion of various advertising into file-based and live streams. The SAPS **116** may function as an advertising insertion module. The SAPS **116** may also include a digital video effects insertion module described below. The function of the automation system **120** will be further described below.

Content repository **104** may also be coupled to a compressed video server **122** and an ad-insertion server **124**. The compressed video server **122** uses content that is retrieved from the content repository well in advance which may be stored therein. Likewise, ads may be also drawn from the content repository **104**. Both the content video server **122** and ad-insertion server **124** provide content in a compressed manner. This is in contrast to the baseband video server **114** that is provided content in a baseband. The output of the content video server may be in an IP transport stream. The content output of the compressed video server **122** and the ad-insertion server **124** may be provided to a local area network **130**.

A traffic scheduling system (TSS) **132** schedules the content throughout the ground segment **100**. The traffic scheduling system **132** generates broadcast schedules utilized by the baseband video servers **114**, the service access processing system **116**, the automation system **120**, the compressed video server **122** and the ad-insertion server **124**. The traffic and scheduling system **132** provides program-associated data (PAD) to a scheduled pad server (SPS) **134**. The SPS **134** delivers the program-associated data to an advanced broadcast controller (ABC) **136**. As will be described below, an advanced broadcast management system illustrated in FIG. **4** may view and edit the program-associated data.

The traffic and scheduling system **132** may also be in communication with an advanced program guide system **138**.

A live content source **40** delivered by way of a satellite optical fiber or copper wires couple live content to an L-band distribution and routing system **142**. Of course, those skilled in the art will recognize various other frequencies may be used for the L-band. The output of the routing system **42** may be provided to ingest channels **150**, turnaround channels **152**, occasional channels **154**, and continental United States local collection facility channels **156**. Each of the various channels **150-156** may represent a number of channels. Each of the channels has primary and secondary or back-up electronics for processing the data stream.

The output of the L-band distribution and routing system **142** provide signals to receivers **160**. As mentioned above, the paths may be in primary or secondary paths. The receivers **160** receive the feed signal from the L-band distribution and routing system **142** and demodulate the feed signal. The receiver may also provide decryption. The feed signal may be in an ATSC-compliant transport stream from terrestrial fiber or satellite sources. The feed signal may also be a DVD-compliant transport stream delivered via satellite or fiber. The signal may also include a digicipher-compliant transport stream, a JPEG 2000 transport stream or various proprietary formats from various content providers. The output of the receiver may be provided via an ASI or MPEG IP interface.

Should the content from the content provider be provided in a format that can be immediately used by the system, the receiver may be replaced with a pass-through connector such as a barrel connector.

The receive signal from the receiver **160** is provided to decoders **162**. The decoders **162** decode the receive signal to provide decoded signals. The receive signal may still be compressed and, thus, the decoder may be used for decoding the live compressed video and audio content. The receive signal may be an ATSC-compliant transport stream, a DVD-compliant transport stream, a digicipher-compliant transport stream, a JPEG 2000 transport stream or various proprietary formats that may be delivered via ASI or MPEG/IP. The output of the decoder is a baseband signal that may be in a variety of formats such as a high definition serial digital interface (HD-SDI) format. The decoders **162** may also include a general purpose interface used to convey add trigger events via contact closures. The input may be delivered directly from an upstream receiver, a conversion box that converts dual-tone multi-frequency tones from the upstream receiver into the general purpose interface. The audio format may carry various types of audio streams including Dolby digital, Dolby E or PCM audio. More than one type of audio stream may be included for a signal. The house signal may also include society of cable telecommunication engineers standard 104 and 35 messages. The house signal may also include closed captioning and vertical interval time code (VITC). It is possible that the decoder may not be required if the content provided from the live content sources in the proper format. Therefore, the decoder is an optional piece of equipment.

For the occasional channels **154**, the output of the decoders **162** may be provided to an occasional HD-SDI routing system **164**. An occasional channel is a live turnaround channel that only exists long enough to carry one or more events, typically sporting events such as those in the NFL or NBA. The type of receiver formatting or authorizations may vary depending on the type of event. Only a small number of receivers are used for these types of events. The routing system **164** allows a proper allocation of downstream equipment in proportion to the number of active broadcast channels rather than the number of content providers.

An insertion module **166** is illustrated as a separate module for the insertion of identification signals into the received signals. The insertion module **166** may also be incorporated into the receiver **160** or the decoder **162**. The insertion module **166** may be used to insert a network name, call letters, a channel name or other source identifiers into the digital stream. Insertion may take place in various places including before the signal is received at a receiver. This may be performed at a content provider facility. For the occasional channels, the output of the routing system is provided to the service access processing system (SAPS) **116**. The output of the decoders **162** in the ingest channels **150**, the turnaround channels **152**, and the CONUS local collection facility channels **156** are each provided to the SAPS **116**.

The SAPS **116** provide baseband processing which may include conversion to a house format and ad-insertion. The SAPS **116** receives a single HD-SDI signal from each decoder **162**. It is possible that the decoder and the SAPS may be combined in one unit. The service access processing system **116** may extract and reinsert various audio streams, such as PCM, Dolby digital, or Dolby E audio. The SAPS **116** may also transcode the signals in the case where a different coding scheme is required. Various operational modes may also be incorporated into the SAPS **116** including frame synchronization, error concealment, and the use of variable incoming bit rates. The SAPS **116** may also support real time changes in the video format. The video format may, for example, be 1080p, 1080i, 720p, and 480p.

Server-based channels **170** may also be included in the system. Server-based channels **170** include a baseband video server **114** that receives content from the content repository **104**.

The primary and back-up baseband video servers **114** of the server-based channels **170** may be coupled to a receiver transfer unit (RTU) **176**. The primary and back-up service access processing system of the turnaround channels **152**, the occasional channels **154**, and the remote collection facility channels **156** may all be coupled to a receiver transfer unit **176**. The receiver transfer unit **176** performs various functions including redundancy switching or selection for choosing between the primary or the back-up outputs of the baseband video server **114** or the service access processing system **116** and providing the chosen signal to an encoder **182**. The receiver transfer units **176** may also route the signals for monitoring and redundancy to an HD-SDI monitoring system **186**. The receiver transfer units **176** may provide an automatic redundancy mode in which the unit fails to a back-up input upon loss of a primary input signal. The RTU **176** may also be implemented so that a switch back from the back-up to the primary unit may not be automatically performed without manual intervention. The receiver transfer unit **176** may be a switch that is controlled by software or the like. In the case of a failure of one of the encoders **182**, a routing system **186** may be used to route the signal through a back-up encoder **190**.

The HD-SDI routing system **186** may provide a plurality of back-up encoders for the various channels.

The encoders **182** and the encoders **190** encode the video audio closed-captioned data VITC and SCTE 35 data associated within a single chain. The output of the encoder is a single program transport stream that is provided by way of an MPEG-IP interface. The single program transport stream (SPTS) is coupled to a local area network **130**. The local area network **130** may include a plurality of router **192** that are used to route the single port transport streams to an uplink signal processing system **200**. Several uplink signal processing systems **200** may be provided. The single program transport stream includes identification of the signal so that it may be properly routed to the proper uplink signal processing system. The uplink signal processing system **200** generates an output to an uplink RF system (URFS) **202**. The uplink signal processing system **200** may also provide redundant pairs to increase the reliability of the output signal.

The uplink signal processing system **200** may include a multiplexing splicing system (MSS) **210**, an advance transport processing system **212**, and a modulator **214**. Pairs of multiplexing splicing systems **210**, advance transport processing systems **212**, and modulators **214** may be provided for redundancy. The multiplexing splicing system **210** multiplexes the single program transport stream from the local area network **130** and may also provide insertion of advertising into the signal. Thus, the MSS acts as a multiplexing module and as an ad insertion module. Various numbers of single-program transport streams may be multiplexed. In one constructed embodiment, eight single program transport streams were multiplexed at each MSS **210**. The ads to be inserted at the MSS **210** may be formatted in a particular format such as MPEG 4 format and have various types of digital including Dolby digital audio streams. The MSS may identify insertion points based on SCTE 35 in the incoming stream.

The advance transport processing system **212** converts the DVB-compliant transport stream from the MSS **210** into an advanced transport stream such as the DIRECTV A3 transport stream. The ATPS **212** may support either ASI or MPEG output interface for the broadcast path. Thus, the ATPS **212** acts as an encryption module. The ATPS **212** may accept data from the advanced broadcast controller **136** and the advanced program guide system **138**. The ATPS **212** may also be coupled to a data broadcast system **226**. The data from the ABC **136**, the APGS **138**, and the DBS **226** are multiplexed into the output transport stream. Thus, the ATPS **212** acts as a data encryption module. As will be described below, the ATPS may also be coupled to the advanced broadcast management system described below in FIG. **4**. Error reporting to the advanced broadcast management system (**300** in FIG. **4**) may include transport level errors, video outages, audio outages, loss of connection from a redundancy controller or a data source, or a compression system controller.

The modulators **214** modulate the transport stream from the ATPS **212** and generate an RF signal at a frequency such as an L-band frequency.

An RF switch **216** is coupled to the primary modulator and back-up modulator **214**. The RF switch provides one output signal to the uplink RF system **202**.

Referring back to the front end of the ground segment **100**, a CONUS local collection facility (CLCF) **226** may be used to collect live content represented by box **228** at a content-provider site or delivered to the CLCF **226** by way of a fiber. A plurality of encoders **230** may be used to encode the signals in a useable format by the system. The encoder signals may be provided to a back hall internet protocol network **232** and provided to a decoder **162** within the CLCF channels **156** or to a receiver **160** in the CLCF. As mentioned above, if the content is formatted in a usable format, the receiver **160** may not be required. Should the receiver function be required, a receiver may be used in the system.

A digital video effects module **240** may also be incorporated into the ground segment **100**. The digital video effects module **240** is used to modify or change the received signal. Various changes may be performed to the received signal to enhance the viewing experience. The signal may be changed when the signal is in the baseband format. In the present application, the high definition serial digital interface (HD-SDI) is used although other interfaces including analog. The digital video effects may include but are not limited to providing a graphics overlay, video resizing, slide playback, logo insertion, and character generation.

DVE module **240** is incorporated after switching to the HD-SDI router **186**, after the encoder **182** and after routing through the LAN **130**. The DVE **240** may represent a plurality of DVEs. The DVE **240** may be incorporated into the multiplexing splicing system (MSS) **210**. Either prior to multiplexing or after multiplexing the signals, digital video effects are inserted into the signal. It should be noted that a numbers of multiplexers (MSS) **210** may be provided for each of the various types and numbers of channels as well as a backup or secondary of each channel (or groups of channels). Each of the multiplexers (MSS) **210** may include or have a DVE associated therewith. Of course channels or groups of channels that never use digital video effects may not include a DVE module for cost savings. The digital video effects may be inserted after multiplexing at the MSS **210** or at or through the ATPS **212**.

Referring now to FIG. **4**, an advanced broadcast management system (ABMS) **300** is illustrated. The ABMS **300** monitors and controls the various functions of the ground segment **200**. The ABMS **300** is coupled to a broadcast control operator (BCO) **302**. The BCO **302** is the primary monitoring control point for various operations. A top-level view of the ground segment **200** may be provided to the broadcast control operator. A summary of the status of each channel may also be provided. The BCO may route channels to a various transponders to various monitors for tracking of ongoing problems.

The ABMS **300** may also be coupled to a broadcast operation supervisor station (BOS) **304**. The broadcast operation supervisor station **304** provides additional monitoring control for operation supervisors in addition to those above described with respect to the BCO **302**. Video monitors of any broadcast channel, as well as routes associated with critical monitoring points, may be provided to the BOS **304**. Also, audio outputs may be selected for monitoring by BOS **304**.

A sports central operator (SCO) **306** is utilized for manual ad-insertions typically during sporting events. The SCO **306** may be used to monitor any broadcast channel in the ground segment **200**. Monitoring a video quality and audio quality may take place at the SCO **306**.

A trigger central system **308** may also be coupled to the ABMS **300**. The trigger central system provides a primary monitoring point for sports-central related activities.

The sports operations supervisor station (SOS) **310** provides an additional monitoring point for the sports central-related activities. The SOS **310** may monitor any broadcast channel in the ground segment **200**.

Quality control stations **312** may also be coupled to the ABMS **300**. The quality control stations may provide primary monitoring and control point for various technical services and support maintenance and troubleshooting activity. The ABMS may include quality control, both in the primary broadcasting center **314** and the diverse uplink facility **316**.

The ABMS **300** may also be coupled to a compression control system (CCS) **340**. The compression control system **340** manages the encoder and MSS devices illustrated in FIG. **3**. The CCS **340** may be responsible for the control and configuration management of the encoder and MSS equipment. Redundancies of the encoder may also be controlled by the CCS **340**. An external interface may be provided at the CCS for encoder and MSS health status monitoring and redundancy control. The total video bandwidth may also be controlled by the CCS through an external interface. The ABMS may also be coupled to the various equipment illustrated in FIG. **3**, such as the RTU **176**, the modulator/RF switch **214/216**, the ATPS **212**, the L band monitoring router **142**, decoders **162**, the SPS **134**, the APGS **138**, the AIS **124**, the CVS **122**, the BVS **114**, and the modulator/RF switch **214/216** of a diverse site.

The ABMS may also be coupled to an integrated receiver decoder **344** that is used for receiving the signals from the satellite to monitor the quality thereof. All other broadcast equipment **346** may also be coupled to the ABMS for control and monitoring purposes.

As mentioned above, the ABMS **300** may include monitoring control functions **350** and may also monitor the Integrated-Receiver-Decoder (IRD) Tuning Control (ITC) **352**. ABMS **300** may also be coupled to the ad insertion server **354**, which is responsible for management of ad content and ad content delivery to the MSS **210**.

Referring now to FIG. **5**, the primary broadcast center **314** and diverse uplink facility **316** are illustrated in further detail. The circuitry within the primary broadcast center **314** is identical to that illustrated above in FIG. **3** except that the ATPS **212** may be coupled to a wide area network **360**. The wide area network **360** provides signals from the primary and back-up ATPS to a diverse uplink facility modulator **362**. Both a primary and back-up uplink modulator **362** may be provided. An RF switch **364** may also be provided. The RF switch **364** may be a similar configuration to switch **216** described above. Likewise, the uplink RF system **366** may also provide a similar function to that described above with respect to uplink RF system **202**.

Referring now to FIG. **6**, a summary of a method of operating the system of FIG. **3** is illustrated. In step **500**, various signals are received. The signals that are received may be file-based content, tape-based content, or live content delivered in various manners including tapes, files, DVDs, satellite, or fibers.

In step **502**, the receive signals may be demodulated if the signals are required. In step **504**, the receive signals are decrypted, also as if required.

In step **506**, the signals are decoded. The decoded signals may be in a high definition serial digital interface (HD-SDI) format. The decoded signals may be provided to a service access processing system or a baseband video system where they may continue to be processed. The service access processing system may convert the signal to baseband. In step **510**, the primary or back-up signals that are converted to baseband may be selected or switched and provided to an encoder for signals not requiring insertion of digital video effects. Also, the switching unit may also provide this signal to a routing system for a monitoring and redundancy check prior to encoding. In step **512**, the switched signals are encoded and in step **514** the signals are routed through a local area network to a multiplexer. In step **515** one or a number of the types of digital video effects may be inserted in the signal. The multiplexer multiplexes the signal in step **516**. Several signals may be multiplexed together. It should be noted that the digital video effects may be inserted after multiplexing and may even be inserted at the ATPS **212**.

In step **518**, the advanced transport processing system may insert various conditional access program guide information or other advertising or other data into the system in step **516**. After step **518**, the signals are modulated in step **520**. Preferably, as mentioned above, a primary and back-up multiplexing system, advance transport processing system and a modulator are provided. In step **522**, switching to the primary or back-up signal is performed in a switch. The output of the switch is used to generate an output signal such as an uplink signal at an uplink RF system in step **524**.

Those skilled in the art can now appreciate from the foregoing description that the broad teachings of the disclosure can be implemented in a variety of forms. Therefore, while this disclosure includes particular examples, the true scope of the disclosure should not be so limited since other modifications will become apparent to the skilled practitioner upon a study of the drawings, the specification and the following claims.

What is claimed is:

1. A method of forming an output signal comprising:

receiving a plurality of signals having a first format;

encoding the plurality of signals into a plurality of transport streams;

after encoding, routing the plurality of transport streams comprising a first transport stream through a local area network to a primary multiplexer in a primary path to form a plurality of primary transport streams having a primary first transport stream and a secondary multiplexer in a secondary path to form a plurality of secondary transport streams having a secondary first transport stream;

communicating a digital video effect to an input of the primary multiplexer and the secondary multiplexer from an ad insertion server;

thereafter, combining the digital video effect into the primary first transport stream of the primary path in the primary multiplexer and the secondary first transport stream of the secondary path in the secondary multiplexer to change a visual display of the primary first transport stream and the secondary first transport stream without removing the primary first transport stream and the secondary first transport stream;

multiplexing the plurality of primary transport streams including the primary first transport stream to form a primary combined signal with the digital video effect in the primary multiplexer;

multiplexing the plurality of secondary transport streams including the secondary first transport stream to form a secondary combined signal with the digital video effect in the secondary multiplexer;

switching between the primary combined signal and the secondary combined signal to form a selected combined signal;

modulating the selected combined signal to form a modulated signal; and

forming the output signal from the modulated signal.

2. A method as recited in claim **1** wherein the switch is disposed after the modulator.

3. A method as recited in claim **1** wherein the digital video effect comprises a graphics overlay.

4. A method as recited in claim **1** wherein the digital video effect comprises video resizing.

5. A method as recited in claim **1** wherein the digital video effect comprises slide playback.

6. A method as recited in claim **1** wherein the digital video effect comprises character generation.

7. A method as recited in claim **1** further comprising prior to the step of combining, communicating the plurality of signals to a monitoring system.

8. A method as recited in claim **7** wherein forming the output signal comprises forming an uplink signal from a diverse site.

9. A method as recited in claim **8** wherein the uplink signal comprises a Ka band uplink signal.

10. An apparatus for generating an output signal comprising:

a receiving system generating a plurality of signals having a first format;

an encoder encoding the plurality of signals into a plurality of transport streams;

a primary multiplexer in a primary path having a first input;

a secondary multiplexer in a secondary path having a second input;

an ad insertion server communicating a digital video effect to the first input and the second input;

a local area network routing the plurality of transport streams to the primary multiplexer to form a plurality of primary transport streams comprising a primary first transport stream and the secondary multiplexer to form a plurality of secondary transport streams comprising a secondary first transport stream;

said primary multiplexer combining the plurality of primary transport streams to form a primary combined signal and combining the digital video effect into the primary first transport stream within the primary combined signal without removing the primary first transport stream;

said secondary multiplexer combining the plurality of secondary transport streams to form a secondary combined signal and combining the digital video effect into the secondary first transport stream within the secondary combined signal without removing the secondary first transport stream;

a switch switching between the primary combined signal and the secondary combined signal to form a selected combined signal;

a modulator modulating the selected combined signal to form a modulated signal; and

a system forming the output signal from the modulated signal.

11. An apparatus as recited in claim **10** wherein the digital video effect comprises a graphics overlay.

12. An apparatus as recited in claim **10** wherein the digital video effect comprises video resizing.

13. An apparatus as recited in claim **10** wherein the digital video effect comprises slide playback.

14. An apparatus as recited in claim **10** wherein the digital video effect comprises character generation.

15. An apparatus as recited in claim **10** further comprising a monitoring system receiving the plurality of signals after the digital video effect is combined.

16. An apparatus as recited in claim **10** wherein a diverse site forms an uplink signal from the diverse site from the output signal.

17. An apparatus as recited in claim **16** wherein the uplink signal comprises a Ka band uplink signal.

18. An apparatus as recited in claim **16** wherein the uplink signal comprises a digital television signal.

19. An apparatus as recited in claim **16** wherein the uplink comprises a high-definition digital television signal.

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